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FOREST SERVICE, U. S. DEPT. OF AGRICULTURE, 6816 MARKET STREET, UPPER DARBY, PA.

E**xperiment Station**

LUMBER GRADE-YIELDS FOR FACTORY- GRADE NORTHERN RED OAK SAWLOGS

Abstract. A report on results of sawing 556 northern red oak sawlogs at four sawmills in West Virginia and Virginia, and the distribution of grades for the standard factory lumber produced. Tabular data on actual yield and curved grade-yield percentages.

As part of a continuing research program, the Forest Service hardwood log and tree grade project is conducting studies to determine the lumber grade-yield of hardwood sawlogs and trees.

In 1964 the project conducted four studies to determine the lumber grade-yield for factory-grade¹ northern red oak (*Quercus rubra* L.) sawlogs. Approximately 60,000 board feet of standard factory lumber² was cut from the 556 study logs. The logs were sawed at three mills in West Virginia and one mill in Virginia. This report gives the results of the sawing studies: both the actual and the curved lumber-grade yield percentages for the study logs.

Field Procedure

The logs used in the study were graded by a forest products technologist according to Forest Service standard grades for hardwood factory-lumber logs.³ The log grade, scaling diameter, length, scalable defect information, and gross and net log scales were recorded for each log in

¹Vaughan, C. L., A. C. Wollin, K. A. McDonald, and E. H. Bulgrin. HARDWOOD LOG GRADES FOR STANDARD LUMBER. U.S. Forest Prod. Lab. Rep. 63, 53 pp., illus. 1966.

²RULES FOR THE MEASUREMENT AND INSPECTION OF HARDWOOD AND CYPRESS LUMBER. National Hardwood Lumber Assn., Chicago, Ill. 112 pp. 1965.

³Ostrander, M.D., and others. A GUIDE TO HARDWOOD LOG GRADING (revised). U.S. Forest Serv. NE. Forest Exp. Sta., 50 pp., illus. Upper Darby, Pa. 1965.

the study. The logs were then sawed, and a tally was made of the length, width, thickness, and grade of each board cut from each log.

After the lumber had air-dried to a moisture content of approximately 20 percent it was regraded and the air-dry grade of each board was tallied by log number to determine air-dry yields for each log.

All the lumber produced in the studies was graded by a National Hardwood Lumber Association certified grader.

Office Procedure

Dry-lumber data were transferred to IBM punch cards, and the data were summarized for each log in the study. The actual air-dry lumber yield percentages were computed by log grade and scaling diameter and are shown in tables 1 to 3. The thickness distribution of the lumber produced in the study is shown in table 4, by lumber grade.

When estimating the lumber grade yield for a group of graded sawlogs, it is better to use curved data because curving data tends to increase the precision of the estimate. For this reason we curved the yield data from tables 1 to 3, using a procedure reported by Jensen.⁴ This method of

⁴Jensen, C. E. THE LEAST SQUARES FIT OF AN ALGEBRAICALLY UNSPECIFIED FORM. U.S. Forest Serv. Res. Note CS-2, 4 pp., illus. Cent. States Forest Exp. Sta. 1963.

Table 1.—*Actual yield, northern red oak grade 1 sawlogs*

Scaling diameter	Logs	Air-dry lumber grade-yields (actual)							Volume lumber tally
		FAS	FASIF	Sel	1C	2C	3A	3B	
<i>Inches</i>	<i>No.</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Bd. ft.</i>
13	12	22.6	15.0	6.7	18.2	19.2	17.1	1.2	1,091
14	17	25.2	13.0	4.4	27.8	16.3	11.1	2.2	2,040
15	18	25.5	14.9	2.6	25.0	21.2	8.7	2.1	2,551
16	22	28.5	14.1	2.8	24.2	17.1	11.7	1.6	3,308
17	22	36.7	13.5	4.0	22.4	15.6	6.1	1.7	4,401
18	14	40.1	16.0	3.6	17.8	13.5	6.9	2.1	2,888
19	16	43.3	14.3	2.7	19.5	13.5	5.5	1.2	3,892
20	8	41.0	14.0	1.4	25.7	9.7	7.2	1.0	1,918
21	4	39.9	16.8	2.2	20.2	13.9	7.0	—	1,072
22	5	55.8	11.2	3.6	12.0	9.3	7.4	.7	1,520
23	2	68.0	8.0	1.0	11.4	10.5	1.1	—	827
24	1	40.7	5.8	5.8	16.7	15.1	10.1	5.8	258
25	1	44.0	6.1	7.5	13.6	16.0	4.3	8.5	375
<i>Total tally, in board feet</i>									
All diameters	142	9,710	3,612	858	5,537	3,918	2,081	425	26,141

Table 2.—*Actual yield, northern red oak grade 2 sawlogs*

Scaling diameter	Logs	Air-dry lumber grade-yields (actual)							Volume lumber tally
		FAS	FASIF	Sel	1C	2C	3A	3B	
<i>Inches</i>	<i>No.</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Bd. ft.</i>
10	8	2.8	8.0	6.2	34.5	20.4	25.0	3.1	388
11	23	8.4	5.1	5.2	22.0	30.7	22.2	6.4	1,453
12	32	8.2	7.5	4.3	24.8	32.1	18.7	4.4	2,495
13	28	5.2	5.6	2.8	31.1	30.6	17.2	7.5	2,406
14	28	9.5	10.5	3.8	27.7	26.2	18.6	3.7	2,801
15	32	14.2	8.4	2.5	29.8	24.7	14.4	6.0	3,937
16	16	7.4	12.2	2.1	29.7	25.9	16.4	6.3	2,205
17	14	20.1	9.5	3.1	33.6	19.6	11.2	2.9	1,986
18	17	12.4	12.3	3.1	28.0	24.6	14.9	4.7	2,889
19	3	14.2	10.9	2.2	43.5	20.3	6.1	2.8	359
20	4	29.0	8.8	1.7	28.9	13.7	8.3	9.6	648
21	1	14.7	5.9	14.7	26.4	14.0	11.8	12.5	136
22	1	69.4	11.4	—	3.9	9.4	5.9	—	307
23	—	—	—	—	—	—	—	—	—
24	2	28.3	17.1	4.7	29.0	17.9	3.0	—	755
<i>Total tally, in board feet</i>									
All diameters	209	2,897	2,132	753	6,510	5,781	3,537	1,155	22,765

Table 3.—*Actual yield, northern red oak grade 3 sawlogs*

Scaling diameter	Logs	Air-dry lumber grade-yields (actual)							Volume lumber tally
		FAS	FASIF	Sel	1C	2C	3A	3B	
<i>Inches</i>	<i>No.</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Bd. ft.</i>
8	23	—	—	3.1	5.0	27.5	41.8	22.6	643
9	35	—	1.2	1.5	14.0	37.0	32.6	13.7	1,265
10	34	1.4	.3	1.4	7.4	35.9	37.0	16.6	1,473
11	30	.8	2.2	1.3	10.6	38.1	34.9	12.1	1,458
12	26	.4	.4	1.3	16.8	33.1	36.0	12.0	1,700
13	20	—	2.5	.3	23.2	33.0	30.0	11.0	1,435
14	20	.8	1.0	.7	17.6	36.6	24.8	18.5	1,738
15	9	—	6.0	1.2	33.6	31.4	22.5	5.3	853
16	6	3.0	5.9	1.9	37.9	32.4	12.0	6.9	725
17	2	—	—	2.0	29.5	33.6	23.5	11.4	149
<i>Total tally, in board feet</i>									
All diameters	205	75	206	143	2,002	3,952	3,526	1,535	11,439

Table 4.—*Thickness distribution of lumber grade-yields,
by log grade and lumber thickness*
(Percent within grade)

Lumber thickness (inches)	FAS	FASIF	Sel	1C	2C	3A	3B
LOG GRADE 1							
5/8	—	—	—	0.1	0.2	0.2	—
3/4	—	—	—	.4	.8	1.9	—
4/4	54.5	72.1	94.9	90.5	98.4	96.9	100.0
5/4	11.7	8.8	3.7	4.3	.6	1.0	—
6/4	33.8	19.1	1.4	4.7	—	—	—
LOG GRADE 2							
5/8	0.2	—	—	0.2	—	—	0.3
3/4	.3	—	—	—	0.5	1.0	3.5
4/4	64.3	77.3	97.5	96.6	98.7	98.1	93.7
5/4	4.6	3.2	2.5	1.4	.7	.9	2.5
6/4	30.6	19.5	—	1.8	.1	—	—
LOG GRADE 3							
5/8	—	—	—	—	0.1	—	—
3/4	—	—	—	0.2	.4	1.5	1.2
4/4	88.0	90.3	100.0	99.6	98.5	97.6	95.9
5/4	—	5.8	—	.2	1.0	.9	2.9
6/4	12.0	3.9	—	—	—	—	—

curving data has been used previously in tree grade lumber-yield development,⁵ and has been found to be applicable to averaging yield values in log- and tree-grade work. Tables 5 to 7 present the curved lumber grade-yield percentages by log grade.

⁵Schroeder, J. G. A TREE GRADING AND VALUATION SYSTEM FOR YELLOW-POPLAR. Forest Prod. J. 14: 521-524, illus. 1964.

Table 5.—*Curved yield, northern red oak grade 1 sawlogs*

Scaling diameter	Logs	Air-dry lumber grade-yields (curved)							Volume lumber tally
		FAS	FASIF	Sel	1C	2C	3A	3B	
<i>Inches</i>	<i>No.</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Bd. ft.</i>
13	12	24	14	5	22	19	15	1	1,091
14	17	24	14	4	25	19	12	2	2,040
15	18	27	14	4	25	18	10	2	2,551
16	22	30	15	4	23	17	9	2	3,308
17	22	34	15	3	22	16	8	2	4,401
18	14	39	14	3	21	14	7	2	2,888
19	16	42	14	3	19	13	7	2	3,892
20	8	45	13	3	19	13	6	1	1,918
21	4	48	13	3	18	11	6	1	1,072
22	5	50	12	3	17	11	6	1	1,520
23	2	53	11	3	16	10	6	1	827
24	1	55	11	2	16	9	6	1	258
25	1	57	10	2	15	9	6	1	375

Total tally, in board feet

All diameters	142	9,710	3,612	858	5,537	3,918	2,081	425	26,141
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Table 6.—*Curved yield, northern red oak grade 2 sawlogs*

Scaling diameter	Logs	Air-dry lumber grade-yields (curved)							Volume lumber tally
		FAS	FASIF	Sel	1C	2C	3A	3B	
<i>Inches</i>	<i>No.</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Bd. ft.</i>
10	8	8	7	5	24	24	25	7	388
11	23	6	7	4	25	30	22	6	1,453
12	32	6	7	4	27	31	20	5	2,495
13	28	7	8	4	28	30	18	5	2,406
14	28	9	9	3	29	28	17	5	2,801
15	32	11	9	3	30	27	15	5	3,937
16	16	13	10	3	30	25	14	5	2,205
17	14	16	10	3	30	23	13	5	1,986
18	17	18	11	3	30	21	12	5	2,889
19	3	20	12	3	30	19	11	5	359
20	4	23	12	3	30	17	10	5	648
21	1	25	13	3	30	16	9	4	136
22	1	27	13	3	29	15	9	4	307
23	—	29	14	3	29	13	8	4	—
24	2	31	14	2	29	13	7	4	755

Total tally, in board feet

All diameters	209	2,897	2,132	753	6,510	5,781	3,537	1,155	22,765
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Table 7.—*Curved yield, northern red oak grade 3 sawlogs*

Scaling diameter	Logs	Air-dry lumber grade-yields (curved)							Volume lumber tally
		FAS	FASIF	Sel	1C	2C	3A	3B	
<i>Inches</i>	<i>No.</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Bd. ft.</i>
8	23	1	—	2	7	31	40	19	643
9	35	1	—	1	8	34	39	17	1,265
10	34	1	1	1	10	36	36	15	1,473
11	30	1	2	1	13	36	33	14	1,458
12	26	1	2	1	16	36	31	13	1,700
13	20	1	2	1	20	35	29	12	1,435
14	20	1	3	1	23	34	26	12	1,738
15	9	1	3	1	28	33	23	11	853
16	6	1	3	1	33	31	21	10	725
17	2	1	3	1	39	29	18	9	149
<i>Total tally, in board feet</i>									
All diameters	205	75	206	143	2,002	3,952	3,526	1,535	11,439

Discussion

A comparison of the lumber grade-yield percentages reported here with previously reported¹ percentages for the combined upland red oak group shows the following:

- For any log grade a higher percentage of No. 1 Common and Better lumber was produced from northern red oak sawlogs than from the combined upland red oak group.
- For any log grade a lower percentage of No. 3B Common lumber was produced from northern red oak sawlogs than from the combined upland red oak group.

The above comparisons indicate that we may have been conservative in our value estimates of northern red oak sawlogs when we based our value estimates on the combined upland red oak tables. Use of these new tables in our future appraisals should result in a closer estimate of the value of northern red oak sawlogs than has been possible in the past.

—JAMES G. SCHROEDER and LELAND F. HANKS⁶



⁶At the time of this study, the authors were forest products technologists on the staff of the Central States Forest Experiment Station, which since has merged with the Northeastern Forest Experiment Station. At present Mr. Schroeder is on the staff of the Southeastern Forest Experiment Station, in Athens, Georgia, and Mr. Hanks is at the Northeastern Forest Experiment Station's research unit in Columbus, Ohio.

